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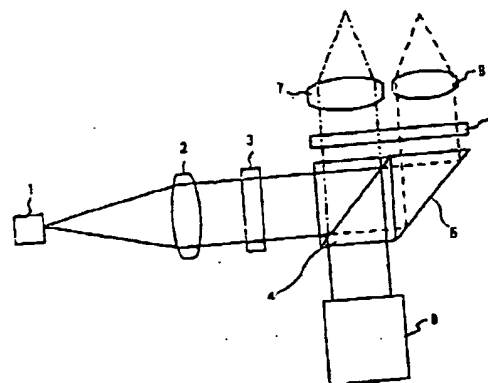
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(54) Optical head device responsive to various optical disks

(57) The present invention provides an optical head device comprising: a light source for emitting a laser beam; a polarization beam splitter for receiving the laser beam and dividing first and second linearly polarized beams having first and second polarization directions which are vertical to each other; an optical transmission system for receiving the first and second polarized beams and respectively transmitting the first and second linearly polarized beams along first and second optical paths which are parallel to each other; a quarter wavelength plate for receiving the first and second linearly polarized beams and converting the first and second linearly polarized beams into first and second circularly polarized beams having polarization planes rotating in first and second directions opposite to each other; and a pair of first and second objective lenses provided for receiving the first and second circularly polarized beams respectively, the first and second objective lenses having first and second focal lengths which are different from each other, so that any one of the first and second circularly polarized beams is focused on an optical disk surface and then the first and second circularly polarized beams are reflected by the optical disk surface and subsequently transmitted through the first and second objective lenses to the quarter wavelength plate whereby the first and second circularly polarized beams are respectively converted into third and fourth linearly polarized beams having the second and first polarization directions respectively before the third and fourth linearly polarized beams are transmitted through the optical transmission system to the polarization beam splitter whereby the third and fourth linearly polarized beams are transmitted along a common optical path to a single optical detecting system.

FIG. 2



- 1: laser beam source
- 2: collimated lens
- 3: polarization converter
- 4: polarization beam splitter
- 5: mirror
- 6: quarter wavelength plate
- 7: first objective lens
- 8: second objective lens
- 9: optical detecting system

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EP 0 789 356 A1

Description

The present invention relates to an optical head device, and more particularly to an optical head device responsible to various optical disks such as a compact disk designed to different regulations in size such as thickness of the disks for recording/replaying of an optical disk medium.

Generally, the optical disk devices have used an optical head having a transparent substrate, through which a laser beam is transmitted to form a micro-spot on a micron-order surface of a storage medium, wherein the transparent substrate protects the micron-order surface of the storage medium. The transparent substrate is a transparent parallel plane plate through which a converging beam is transmitted, for which reason a wave-front aberration depending upon a thickness of the parallel plane substrate appears on the transmitting beam. If the wave-front aberration is large, then a convergence spot is enlarged to beyond over a diffraction limit whereby it is made difficult to obtain desired recording/replaying properties. In order to settle those problems, it is required to form a micro-spot as small as possible in the light of diffraction limit on the storage medium surface to compensate such wave-front aberration.

By the way, the regulation in thickness of the optical disk is variable for usage purposes. If the thickness of the optical disk is varied, then the amount of the compensation to the wave-front aberration is also varied, for which reason the conventional optical head is responsible for recording/replaying the optical disk medium having a certain thickness and being designed under a certain regulation. Namely, the conventional optical head is not responsible to the various optical disk mediums designed in accordance with the various regulations.

In order to settle the above problem, an optical head device was proposed, which is capable of switching twin lenses in accordance with the various optical disks wherein the twin lenses are mounted on an actuator. This optical head device is disclosed in the "TECHNICAL REPORT OF THE INSTITUTE OF ELECTRONICS INFORMATION AND COMMUNICATION ENGINEERS", MR95-25, August 1995.

FIG. 1 is illustrative of a mechanical structure of the actuator provided in the above conventional optical head device having twin lenses. The actuator is provided with a movable plate 10 on which a first objective lens 7 and a second objective lens 8 are mounted. The movable plate 10 is provided to rotate around an axis 21 in a predetermined angle range. The first and second objective lenses 7 and 8 are provided to be distanced from the axis 21 around which the movable plate 10 rotates so that the first and second objective lenses 7 and 8 are switched by the rotation of the movable plate 10. Either a reflective mirror or a reflective prism is provided on a base of the actuator so that the reflective mirror or the reflective prism is fixed to be positioned under one of

the first and second objective lenses 7 and 8. An incident beam 20 is reflected by the reflective mirror or the reflective prism. The movable plate 10 has a side edge on which a pole piece 22 is formed. A magnet 24 is provided to be slightly distanced from the pole piece to provide a magnetic force to the pole piece 22 whereby the movable plate 10 is forced to rotate around the axis 21. A tracking coil 23 is provided on the magnet 24 so that a large current is applied on the tracking coil 23 so as to rotate the movable plate 10 for switching the first and second objective lenses 7 and 8. Bistable points exist in the magnetic field between the magnet 24 and the pole piece 22 so that the movable plate 10 are stable in the bistable points of the magnetic field wherein the first and second objective lenses 7 and 8 are positioned over the reflective mirror or the reflective prism. The tracking is made around the axis 21, in the light of which the movable plate 10 is made rotate at a larger angle than in the tracking process, so as to switch the first and second objective lenses 7 and 8. The first and second lenses 7 and 8 are adjusted to the different two optical disks having different thicknesses so that the above optical head is responsible to two different optical disks having different thicknesses by switching the first and second objective lenses adjusted to that two different optical disks.

For the above conventional optical head, the slidable and rotatable actuator which is allowed to rotate at a relatively large angle is usable. Notwithstanding, wire-supporting actuator or a plate spring supporting actuator are not available due to those small movable ranges even those actuators have widely been used.

In the above circumstances, it had been required to develop a novel twin lens optical head device responsible to two different optical disks having different thicknesses but not limiting the type of the actuator or allowing various types of the actuator.

It has been also required to develop a novel twin lens optical head device responsible to two different optical disks having different thicknesses and capable of recording/replaying operations with a considerably reduced optical loss.

Accordingly, it is an object of the present invention to provide a novel optical head device with twin lenses responsible to two different optical disks having different thicknesses, which allows various types of actuators.

It is a further object of the present invention to provide a novel optical head device with twin lenses responsible to two different optical disks having different thicknesses and capable of recording/replaying operations with a considerably reduced optical loss.

The above and other objects, features and advantages of the present invention will be apparent from the following descriptions.

The present invention provides an optical head device comprising: a light source for emitting a laser beam; a polarization beam splitter for receiving the laser beam and dividing first and second linearly polarized beams having first and second polarization directions

EP 0 789 358 A1

3

which are vertical to each other; an optical transmission system for receiving the first and second polarized beams and respectively transmitting the first and second linearly polarized beams along first and second optical paths which are parallel to each other; a quarter wavelength plate for receiving the first and second linearly polarized beams and converting the first and second linearly polarized beams into first and second circulatory polarized beams having polarization planes rotating in first and second directions opposite to each other; and a pair of first and second objective lenses provided for receiving the first and second circularly polarized beams respectively, the first and second objective lenses having first and second focal lengths which are different from each other, so that any one of the first and second circulatory polarized beams is focused on an optical disk surface and then the first and second circulatory polarized beams are reflected by the optical disk surface and subsequently transmitted through the first and second objective lenses to the quarter wavelength plate whereby the first and second circulatory polarized beams are respectively converted into third and fourth linearly polarized beams having the second and first polarization directions respectively before the third and fourth linearly polarized beams are transmitted through the optical transmission system to the polarization beam splitter whereby the third and fourth linearly polarized beams are transmitted along a common optical path to a single optical detecting system.

Preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings.

FIG. 1 is a perspective view illustrative of a mechanical structure of the actuator provided in the above convention optical head device having twin lenses.

FIG. 2 is a schematic diagram illustrative of a structure of a novel optical head device having twin lenses responsible to two different optical disks having different thicknesses in a preferred embodiment according to the present invention.

FIG. 3 is a perspective view illustrative of an actuator provided in a novel optical head device having twin lenses responsible to two different optical disks having different thicknesses in a preferred embodiment according to the present invention.

FIG. 4 is a schematic and fragmentary cross sectional elevation view illustrative of twin objective lenses for explaining how to avoid a problem with stray light, involved in a novel optical head device having twin lenses responsible to two different optical disks having different thicknesses in a preferred embodiment according to the present invention.

FIG. 5 is a perspective view illustrative of a polarization converter provided in a novel optical head device having twin lenses responsible to two different optical disks having different thicknesses in a preferred embodiment according to the present invention.

FIG. 6 is a perspective view illustrative of a polarization beam splitter united with mirrors used in a novel optical head device having twin lenses responsible to two different optical disks having different thicknesses in a preferred embodiment according to the present invention.

FIGS. 7A through 7D are diagrams illustrative of polarization of an output laser beam emitted by a novel optical head device having twin lenses responsible to two different optical disks having different thicknesses in a preferred embodiment according to the present invention.

The present invention provides an optical head device comprising: a light source for emitting a laser beam; a polarization beam splitter for receiving the laser beam and dividing first and second linearly polarized beams having first and second polarization directions which are vertical to each other; an optical transmission system for receiving the first and second polarized beams and respectively transmitting the first and second linearly polarized beams along first and second optical paths which are parallel to each other; a quarter wavelength plate for receiving the first and second linearly polarized beams and converting the first and second linearly polarized beams into first and second circulatory polarized beams having polarization planes rotating in first and second directions opposite to each other; and a pair of first and second objective lenses provided for receiving the first and second circularly polarized beams respectively, the first and second objective lenses having first and second focal lengths which are different from each other, so that any one of the first and second circulatory polarized beams is focused on an optical disk surface and then the first and second circulatory polarized beams are reflected by the optical disk surface and subsequently transmitted through the first and second objective lenses to the quarter wavelength plate whereby the first and second circulatory polarized beams are respectively converted into third and fourth linearly polarized beams having the second and first polarization directions respectively before the third and fourth linearly polarized beams are transmitted through the optical transmission system to the polarization beam splitter whereby the third and fourth linearly polarized beams are transmitted along a common optical path to a single optical detecting system.

It is possible that a polarization converter is further provided between the light source and the polarization beam splitter for converting a transmittable linearly polarized beam in polarization direction. In this case, it is preferable that the polarization converter comprises a half-wavelength plate so movable as to be on and off an optical path along which the laser beam is transmitted. Alternatively, it is also preferable that the polarization converter comprises a half-wavelength plate capable of rotating a crystal axis direction.

It is further preferable that the light source is capa-

ble of emitting any one of the first and second linearly polarized beams.

It is furthermore preferable that the optical transmission system comprises a single mirror provided adjacent to the polarization beam splitter for reflecting one of the first and second linearly polarized beams divided by the polarization beam splitter.

It is still further preferable that the optical transmission system comprises two mirrors provided adjacent to the polarization beam splitter at different two sides for reflecting the first and second linearly polarized beams divided by the polarization beam splitter.

A preferred embodiment according to the present invention will be described with reference to the drawings, in which a novel optical head device is provided, which has twin lenses responsible to two different optical disks having different thicknesses.

A laser beam source 1 is provided for emitting a laser beam which is divergent. A collimated lens 2 is provided which is distanced from the laser beam source 1 so that the laser beam emitted from the laser beam source 1 is transmitted through the collimated lens 2 whereby the divergent laser beam is converted into a parallel laser beam with no divergence nor convergence. A polarization converter 3 is provided which is distanced from the collimated lens 2 whereby the parallel laser beam is transmitted through the polarization converter 3 for polarizing the parallel laser beam so that the parallel laser beam has a P-polarized component and an S-polarized component as illustrated in FIG. 7A. A polarization beam splitter 4 is further provided, which is distanced from the polarization converter 3 so that the polarized parallel laser beam including both the P-polarized component and the S-polarized component illustrated in FIG. 7A is made incident to the polarization beam splitter 4 whereby the polarized parallel laser beam is isolated into the P-polarized beam and the S-polarized beam as illustrated in FIG. 7B. If the polarization beam splitter 4 is designed to reflect the S-polarized beam, then the above S-polarized beam is reflected, by the polarization beam splitter 4, to be transmitted in a vertical direction to the direction in which the laser beam has been transmitted. By contrast, the P-polarized beam is not reflected by but transmitted straight through the polarization beam splitter 4. A reflecting mirror 5 is provided adjacent to the polarization beam splitter 4 so that the P-polarized having been transmitted straight through the polarization beam splitter 4 is reflected, by the mirror 5, to be transmitted in the same direction as the direction in which the S-polarized beam is transmitted or vertical to the direction in which the laser beam has been transmitted before entry into the polarization beam splitter 4. As a result, the P-polarized beam having been reflected by the mirror 5 is transmitted in parallel to but distanced from the S-polarized beam having been reflected by polarization beam splitter 4. A quarter wavelength plate 6 is provided which faces to the polarization beam splitter 4 and the mirror 5 so that both the P-po-

larized beam having been reflected by the mirror 5 and the S-polarized beam having been reflected by polarization beam splitter 4 are transmitted through the quarter wavelength plate 6 whereby, as illustrated in FIG. 7C, the S-polarized beam is made into a first circularly polarized beam having a polarization plane rotating in the anti-clockwise direction whilst the P-polarized beam is made into a second circularly polarized beam having a polarization plane rotating in the clockwise direction. First and second objective lenses 7 and 8 are provided to face to the quarter wavelength plate 6. The first and second objective lenses 7 and 8 are aligned in parallel to the surface of the quarter wavelength plate 6 so that the first circularly polarized beam with the first polarization plane rotating in the anti-clockwise direction having been reflected by the polarization beam splitter 4 is transmitted through the first objective lens 7 whilst the second circularly polarized beam with the polarization plane rotating in the clockwise direction having been reflected by the mirror 5 is transmitted through the second objective lens 8. The first and second objective lenses 7 and 8 are differently adjusted to two optical disks which differ in thickness from each other to accord to two different regulations. The first and second circularly polarized beams have been transmitted through the first and second objective lenses 7 and 8 respectively show different convergence so that the first and second circularly polarized beams are focused on surfaces of the different two optical disks which differ in thickness from each other to accord to two different regulations. That is why as illustrated in FIG. 2, the first circularly polarized beam having been transmitted through the first objective lens 7 is focused at a position being far from the first objective lens 7 more than a position at which the second circularly polarized beam has been transmitted through the second objective lens 8 is focused. The optical disk, on which the first circularly polarized beam has been transmitted through the first objective lens 7 is focused, is larger in thickness than the other optical disk on which the second circularly polarized beam has been transmitted through the first objective lens 7 is focused. This means that the surface of the optical disk, on which the first circularly polarized beam is focused, has a larger distance from the first objective lens 7 than a distance between the second objective lens 8 and the other optical disk on which the second circularly polarized beam is focused. The first circularly polarized beam having been transmitted through the first objective lens 7 is focused on the optical disk whilst the second circularly polarized beam having been transmitted through the second objective lens 8 is focused on the other optical disk having a larger thickness than the above optical disk. The first and second circularly polarized beams are reflected by the surfaces of the optical disks and then transmitted return to the first and second objective lenses 7 and 8. The first and second circularly polarized beams having been reflected are transmitted with divergence and enter into the first and second ob-

jective lenses 7 and 8 whereby the first and second circularity polarized beams are made into first and second parallel beams. The first and second parallel beams having been transmitted through the first and second objective lenses 7 and 8 enter into the quarter wavelength plate 8 whereby the first and second parallel beams circulatory polarized in the anti-clockwise and clockwise directions are made into the P-polarized and S-polarized beams as illustrated in FIG. 7D.

As described above, the laser beam emitted from the laser beam source 1 is polarized by the polarization converter 3 to have S-polarized component and P-polarized component. The polarized laser beam is then divided by the polarization beam splitter 4 into the S-polarized beam and P-polarized beam. Since the polarization beam splitter 4 is designed to reflect the S-polarized component but transmit the P-polarized component straight, the S-polarized beam is reflected by the polarization beam splitter 4 and then transmitted in the vertical direction to the direction in which the beam has already been transmitted until a position of the polarization beam splitter 4. By contrast, the P-polarized beam is transmitted straight through the polarization beam splitter 4 and enters into the mirror 5 whereby the P-polarized beam is reflected and then transmitted in the vertical direction to the direction in which the beam has already been transmitted. The S-polarized beam having been reflected by the polarization beam splitter 4 and the P-polarized beam having been reflected by the mirror 5 are transmitted through the quarter wavelength plate 6 whereby the S-polarized beam is made into the first circulatory polarized beam with the polarization plane rotating in the anti-clockwise direction whilst the P-polarized beam is made into the second circulatory polarized beam with the polarization plane rotating in the clockwise direction. The first and second circulatory polarized beams are then transmitted through the first and second objective lenses 7 and 8 to be focused on the two optical disks differing in thickness from each other, and then reflected by the two optical disks whereby the first and second circulatory polarized beams enter into the quarter wavelength plate 6 again. As a result, the first and second circulatory polarized beams are made by the quarter wavelength plate 6 into the P-polarized and S-polarized beams respectively. The P-polarized beam enters into the polarization beam splitter 4. The S-polarized beam enters into the mirror 5 and then reflected by the mirror 5 to be transmitted in the reverse direction to the direction in which the beam has been transmitted from the laser beam source 1 through the collimated lens 2 and the polarization converter 3. The S-polarized beam reflected by the mirror 5 enters into the polarization beam splitter 4. As described above, since the polarization beam splitter 4 is designed to reflect the S-polarized component but transmit the P-polarized component straight, the S-polarized beam is further reflected by the polarization beam splitter 4 to be transmitted in the vertical direction to the direction in

which the beam has been transmitted from the laser beam source 1 through the collimated lens 2 and the polarization converter 3. The above vertical direction is reverse to the direction in which the beam is transmitted from the quarter wavelength plate 6 to the objective lenses 7 and 8. Thus, the S-polarized beam having been reflected by the polarization beam splitter 4 is then transmitted in the opposite side to the objective lens. Since the P-polarized beam having been transmitted through the first objective lens 7 and the quarter wavelength plate 6 is then transmitted straight through the polarization beam splitter 4. An optical detecting system 9 is provided at an opposite side to the first objective lens 7 with reference to the polarization beam splitter 4 so that the P-polarized beam having been transmitted straight through the polarization beam splitter 4 and the S-polarized beam having been reflected by the polarization beam splitter 4 are received by the optical detecting system 9.

From the above descriptions, it can be understood that the beam emitted from the laser beam source 1 is transmitted up to the optical detecting system 9 with only an optical dividing loss when the beam is divided into the S-polarized and P-polarized beams by the polarization beam splitter 4. This means that the S-polarized and P-polarized beams once divided from the beam emitted from the laser beam source 1 are transmitted up to the optical detecting system 9.

Whereas it may be proposed to use the beam splitter without any polarization property for the purpose of dividing the beam into the two beams to be transmitted in different directions, the divided beams are reflected by the optical disks and then each of the divided beams is further divided by the beam splitter into the two twice-divided beams to be transmitted in the different directions. As a result, all of the twice-divided beams are not transmitted to the optical detecting system 9. This means that a certain optical dividing loss appears.

Both the above two S-polarized and P-polarized beams are transmitted to enter into the optical detecting system 9 along the common optical axis, for which reason only a single optical detecting system is responsible to two beams having been transmitted through the first and second objective lenses respectively. As the optical detecting system 9, any servo-error detecting methods already known are available such as a knife edge method, an astigmatism method, a push-pull method, and a heterodyne method.

As described above, the first and second lenses 7 and 8 are designed for the different optical disks having different thickness to accord to the different regulations and the first and second lenses 7 and 8 are provided to face to the different two optical disks respectively, for which reason it is not necessary to switch the first and second objective lenses 7 and 8.

An actuator illustrated in FIG. 3 is available. A movable portion 10 is supported by spring plates 12 which are fixed to a base portion 11. The above first and sec-

9

EP 0 789 356 A1

10

ond objective lenses 7 and 8 are provided.

As illustrated in FIG. 4, the first and second objective lenses 7 and 8 have different focal distances so as to avoid any problem with stray light. If the beam having been transmitted through the first objective lens 7 is focused on the optical disk 13, then the beam having been transmitted through the second objective lens 8 is not focused on the optical disk 13. Thus, the beam reflected by the optical disk 13 and then transmitted through the second objective lens is not collimated but is diverging light, for which reason a majority part of the diverging light is not transmitted to the optical detecting system 9, provided a diameter of the optical element is sufficiently small. This means that the intensity of the stray light is so low as substantially ignoble.

It is also possible to settle the above problem with stray light by having the beam incident to any one of the first and second objective lenses, for example, by rotating the polarization plane since the polarization converter is provided between the laser beam source 1 and the polarization beam splitter 4.

If the polarization converter 3 transmits only the S-polarized beam, then the beam is incident only to the first objective lens 7. If, however, the polarization converter 3 transmits only the P-polarized beam, then the beam is incident only to the second objective lens 8. In this case, however, there is no problem with stray light nor disadvantage in generation of any optical dividing loss.

The polarization converter may comprise a half-wavelength plate 14 movable by a solenoid coil 15 as illustrated in FIG. 5. The laser beam source 1 emits a laser beam which is P-polarized. The half-wavelength plate 14 is set so that a crystal axis is 45 degrees to the incident path of the P-polarized beam. If this half-wavelength plate 14 is positioned on the path of the P-polarized beam so that the P-polarized beam is transmitted through the half-wavelength plate 14, then the P-polarized beam is converted by the half-wavelength plate 14 into the S-polarized beam. The S-polarized beam is then transmitted through the first objective lens 7 onto the optical disk. If, however, the above half-wavelength plate 14 is moved out of the path of the P-polarized beam by the solenoid coil 15, then the P-polarized beam is then transmitted to the second objective lens 8.

If, contrary to the above polarization beam splitter 4, the polarization beam splitter 4 is designed to reflect P-polarized beam and transmit S-polarized beam, then the P-polarized beam is transmitted through the first objective lens and the S-polarized beam is transmitted through the second objective lens.

In the above optical system, the lengths of the two optical paths are different. Notwithstanding, it is possible to set the two optical paths at the same length by using two mirrors as illustrated in FIG. 6 wherein both the S-polarized and P-polarized beams are reflected by the two mirrors respectively and then enter into the first and second objective lenses 7 and 8. In this case, it is possible

to use, in place of the collimated lens 2, the objective lens of finite system so that the hole structure is made simple.

In place of the movement of the half-wavelength plate 14 by use of the solenoid coil 15, it is also possible to rotate the crystal axis direction of the half-wavelength plate 14 by 45 degrees for switching the type of the polarization of the transmittable beam.

It is also possible not to use the polarization converter 3. In this case, the first and second objective lenses 7 and 8 have different focal distances as described above with reference to FIG. 4 in order to avoid any problem with stray light.

In place of the first and second objective lenses 7 and 8 being provided on the single movable plate 10 illustrated in FIG. 3, the first and second objective lenses 7 and 8 may be provided on different two movable plates respectively.

Whereas modifications of the present invention will be apparent to a person having ordinary skill in the art, to which the invention pertains, it is to be understood that embodiments as shown and described by way of illustrations are by no means intended to be considered in a limiting sense. Accordingly, it is to be intended to cover by claims any modifications of the present invention which fall within the spirit and scope of the present invention.

Claims

1. An optical head device comprising:

- a light source for emitting a laser beam ;
- a polarization beam splitter for receiving said laser beam and dividing first and second linearly polarized beams having first and second polarization directions which are vertical to each other ;
- an optical transmission system for receiving said first and second polarized beams and respectively transmitting said first and second linearly polarized beams along first and second optical paths which are parallel to each other ;
- a quarter wavelength plate for receiving said first and second linearly polarized beams and converting said first and second linearly polarized beams into first and second circulatory polarized beams having polarization planes rotating in first and second directions opposite to each other ;
- a pair of first and second objective lenses provided for receiving said first and second circulatory polarized beams respectively, said first and second objective lenses having first and second focal lengths which are different from each other,
- so that any one of said first and second circu-

11

EP 0 789 356 A1

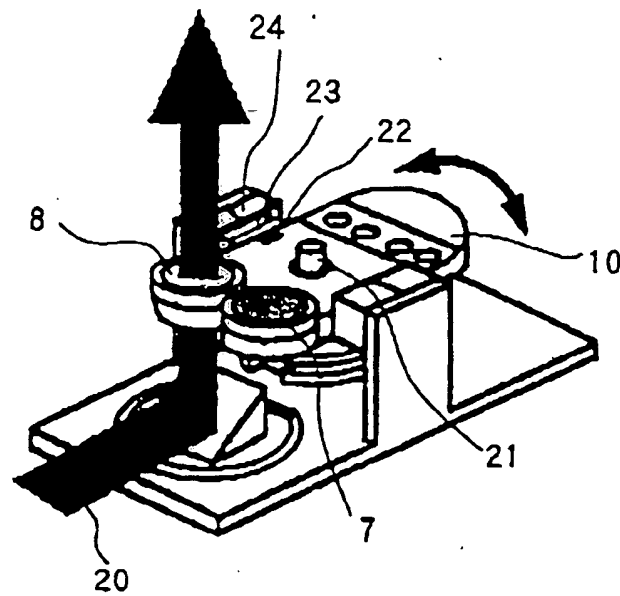
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latory polarized beams is focused on an optical disk surface and then said first and second circulatory polarized beams are reflected by said optical disk surface and subsequently transmitted through said first and second objective lenses to said quarter wavelength plate whereby said first and second circulatory polarized beams are respectively converted into third and fourth linearly polarized beams having said second and first polarization directions respectively before said third and fourth linearly polarized beams are transmitted through said optical transmission system to said polarization beam splitter whereby said third and fourth linearly polarized beams are transmitted along a common optical path to a single optical detecting system.

2. The optical head device as claimed in claim 1, further comprising a polarization converter provided between said light source and said polarization beam splitter for converting a transmittable linearly polarized beam in polarization direction.
3. The optical head device as claimed in claim 2, characterized in that said polarization converter comprises a half-wavelength plate so movable as to be on and off an optical path along which said laser beam is transmitted.
4. The optical head device as claimed in claim 2, characterized in that said polarization converter comprises a half-wavelength plate capable of rotating a crystal axis direction.
5. The optical head device as claimed in claim 1, characterized in that said light source is capable of emitting any one of said first and second linearly polarized beams.
6. The optical head device as claimed in claim 1, characterized in that said optical transmission system comprises a single mirror provided adjacent to said polarization beam splitter for reflecting one of said first and second linearly polarized beams divided by said polarization beam splitter.
7. The optical head device as claimed in claim 1, characterized in that said optical transmission system comprises two mirrors provided adjacent to said polarization beam splitter at different two sides for reflecting said first and second linearly polarized beams divided by said polarization beam splitter.

EP 0 789 356 A1

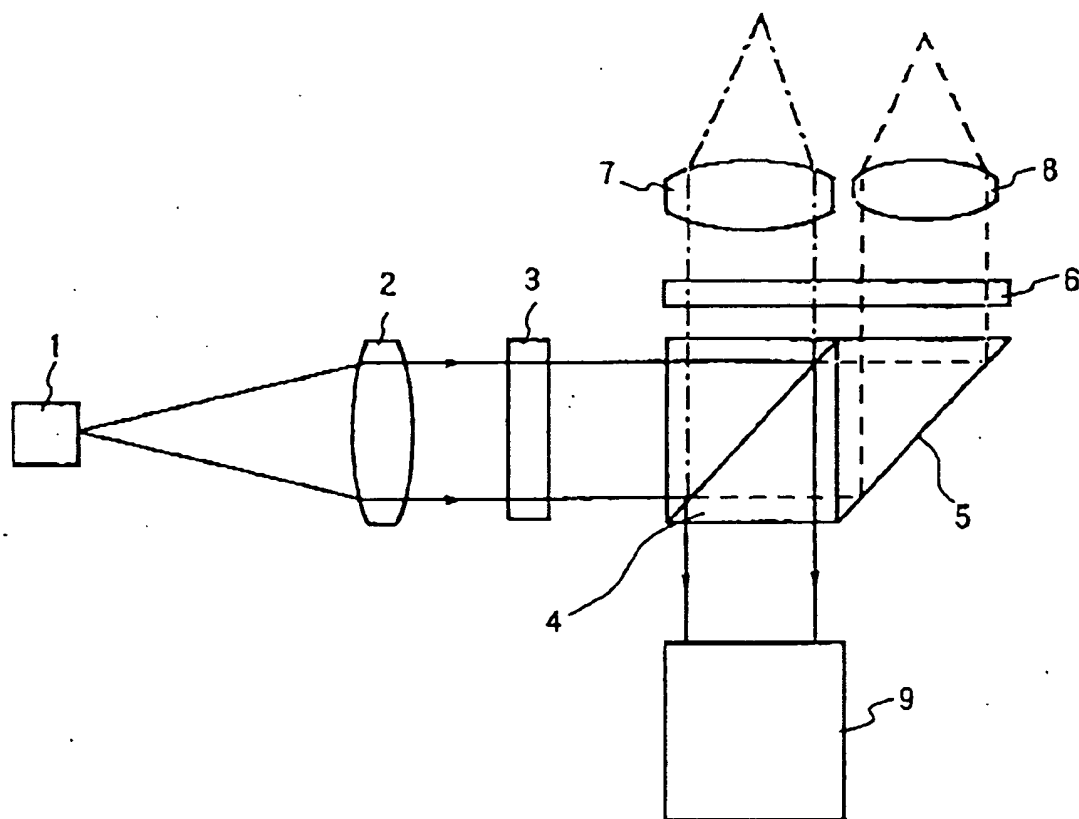
FIG. 1 PRIOR ART



- 7 : first objective lens
- 8 : second objective lens
- 10 : movable section
- 20 : incident beam
- 21 : axis
- 22 : pole piece
- 23 : coil
- 24 : magnet

EP 0 789 356 A1

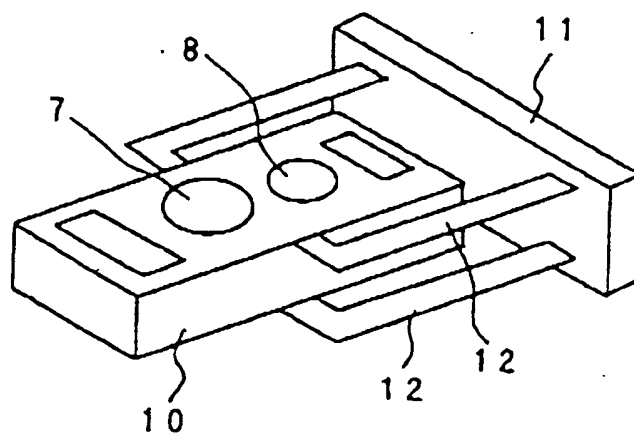
FIG. 2



- 1 : laser beam source
- 2 : collimated lens
- 3 : polarizaion converter
- 4 : polarization beam splitter
- 5 : mirror
- 6 : quater wavelength plate
- 7 : first objective lens
- 8 : second objective lens
- 9 : optical detecting system

EP 0 789 356 A1

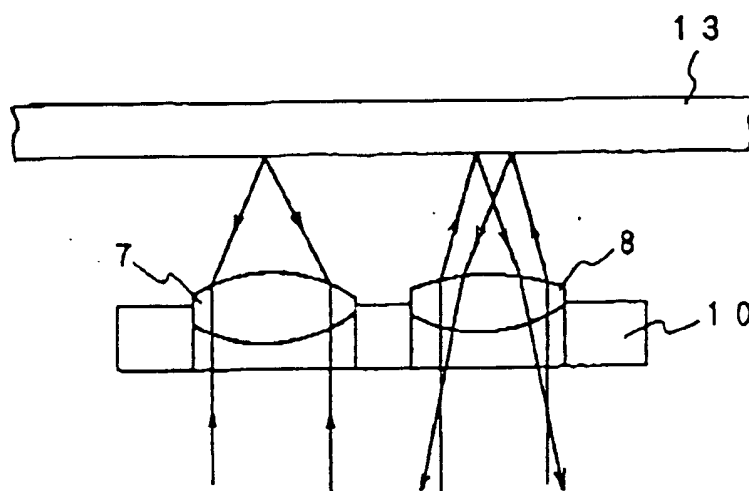
FIG. 3



- 7 : first objective lens
- 8 : second objective lens
- 10 : movable portion
- 11 : fixed portion
- 12 : spring plate

EP 0 789 356 A1

FIG. 4



7 : first objective lens

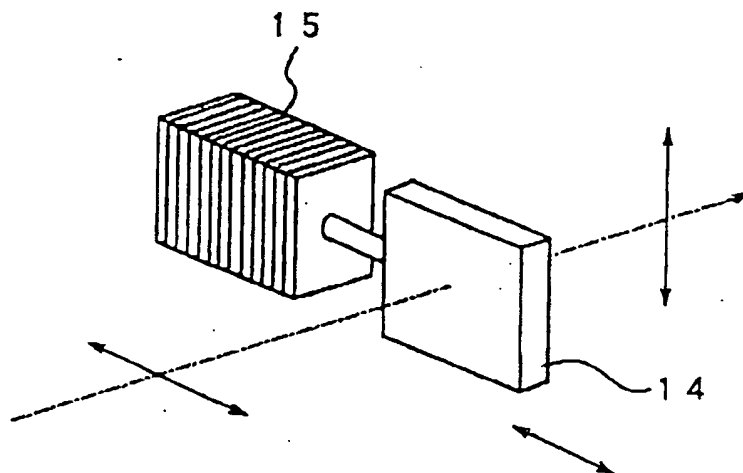
8 : second objective lens

10 : movable portion

13 : optical disk

EP 0 789 358 A1

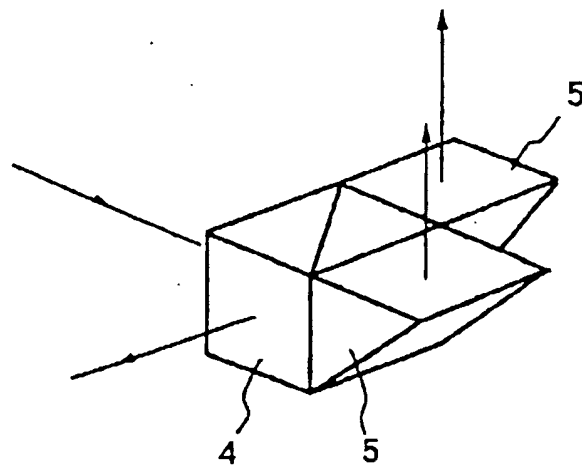
FIG. 5



14 : quarter wavelength plate
15 : solenoid coil

EP 0 789 356 A1

FIG. 6

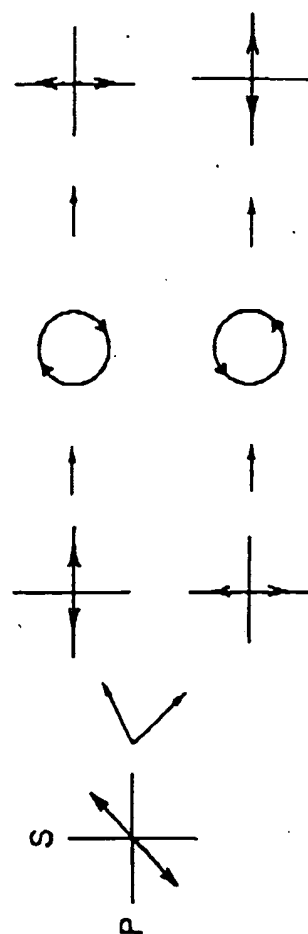


4 : polarization beam splitter

5 : mirror

EP 0 789 356 A1

FIG. 7A FIG. 7B FIG. 7C FIG. 7D



EP 0 789 356 A1



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 97 10 1917

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 470 807 A (HATSUSHITA ELECTRIC IND CO LTD) * column 12, line 28-58; claims 1,4; figure 8 *	1	611B7/135 611B7/12
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A	--- PATENT ABSTRACTS OF JAPAN vol. 8, no. 275 (P-321), 15 December 1984 & JP 59 142758 A (SUWA SEIKOSHA KK), 16 August 1984, * abstract *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6) 611B
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 12 May 1997	Examiner Bernas, Y
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